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Service Manual

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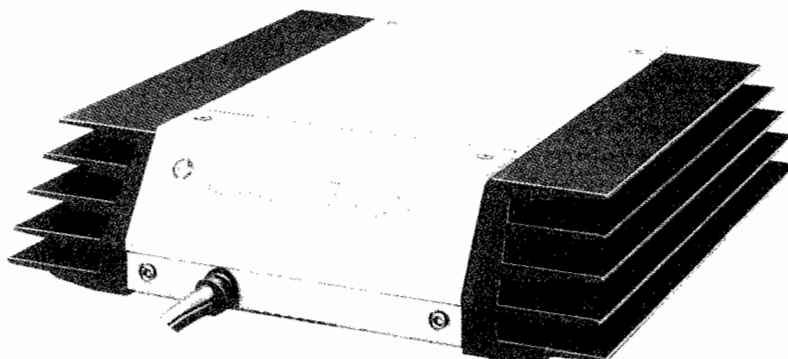
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Model 802HA (GA-827E)



SPECIFICATIONS:

Circuit system: W-servo regulator
 PWM ± 2 power units
 Full complementary circuit
 with all-stage direct connection
 Dual FET differential input
 circuit
 Current mirror load circuit
 DC servo circuit
 Rated power: 80W + 80W
 (with 15% distortion)
 Load impedance: $4\Omega \times 2$
 Power supply voltage:
 DC 14.4V
 (Negative ground)
 Current consumption:
 20A (at rated power)
 Dimensions: Width 214mm
 Height 51mm
 Depth 232mm
 Weight: 2.3kg

COMPONENTS:

GA-827E-51

Main unit		1
Parts bag	921-8192-00	1
Mounting bracket	300-6399-00	2
Lead holder	335-0833-01	5
Tap-screw (M5x20)	700-5020-80	4
Plate nut	725-0216-00	4
Sems screw (M4x8)	732-4008-11	4
Extension lead	852-8747-00	1

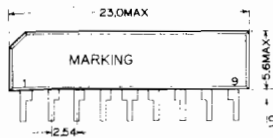
FEATURES:

- Maximum output 80W + 80W
- W-servo regulator
- DC-servo amplifier circuit
- Protection circuit
- Aluminium alloy extruded heat sink

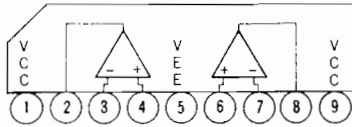
■EXPLANATION OF IC's:

■NJM4560S 051-0285-56 Dual OP. Amp.

Outward Form



Block Diagram



Maximum Ratings (Ta=25°C)

Item	Symbol	Rating	Unit
Supply voltage	V ⁺ /V ⁻	±18	V
Differential input voltage	V _{IO}	±30	V
Input voltage	V _I	±15	V
Power dissipation	P _D	500	mW

Electrical Characteristics (Ta=25°C, V⁺=15V, V⁻= -15V)

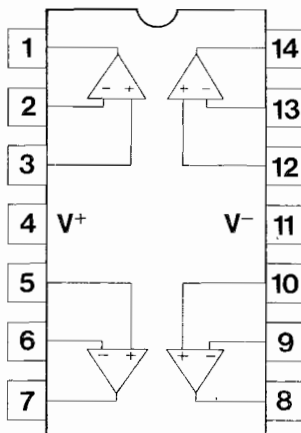
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Input offset voltage	V _{IO}	R _S ≤ 10kΩ	—	0.5	6	mV
Input offset current	I _{IO}		—	10	200	nA
Input bias current	I _{IB}		—	80	500	nA
Input resistance	R _{IO}		0.3	5	—	MΩ
Voltage gain	A _V	R _L ≥ 2kΩ, V _O = ±10V	20	100	—	×10 ³
Maximum output voltage	V _{OM}	R _L ≥ 2kΩ I _O = 25mA	±12 ±10	±14 ±11.5	—	V
Common mode input range	V _{ICM}		±12	±14	—	V
Common mode rejection ratio	CMRR	R _S ≤ 10kΩ	70	90	—	dB
Supply voltage rejection ratio	SVRR	R _S ≤ 10kΩ	—	30	150	μV/V
Power dissipation	P _D		—	105	170	mW
Slew rate	SR	R _L ≥ 2kΩ	—	4	—	V/μs

■NJM2902N 051-0287-50 Quad OP. Amp.

Outward Form



Block Diagram



Maximum Ratings (Ta=25°C)

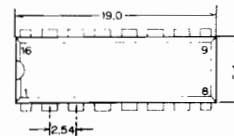
Item	Symbol	Rating	Unit
Supply voltage	V ⁺	32 (±16)	V
Differential input voltage	V _{IO}	32	V
Input voltage	V _I	-0.3 ~ +32	V
Power dissipation	P _D	300	mW

Electrical Characteristics (Ta=25°C, V⁺=5V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Input offset voltage	V _{IO}	R _S = 0Ω	—	2	10	mV
Input offset current	I _{IO}	I _{R(+)} = I _{R(-)}	—	5	50	nA
Input bias current	I _{IB}	I _{I(+)} or I _{I(-)}	—	45	500	nA
Voltage gain	A _V	R _L ≥ 2kΩ	—	100	—	V/mV
Common mode input range	V _{OPP}		0 ~ 3.5	—	—	V
Common mode rejection ratio	CMR		—	85	—	dB
Supply voltage rejection ratio	SVR		—	100	—	dB

■NJM3524 051-0749-00 PWM Switching Regulator Controller

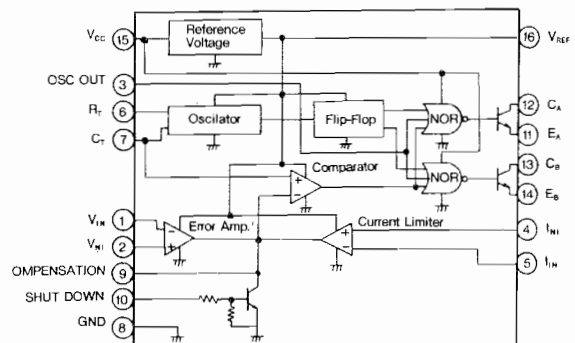
Outward Form



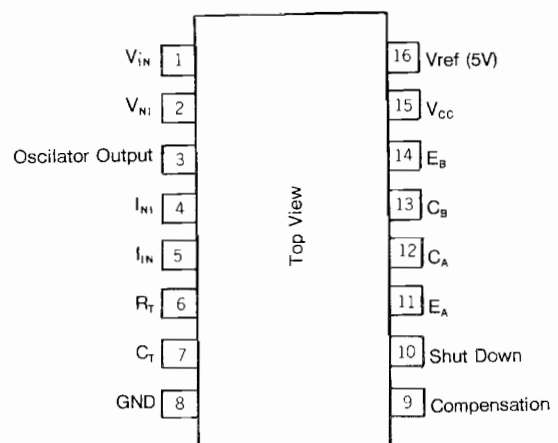
Maximum Ratings (Ta=25°C)

Item	Symbol	Rating	Unit
Supply voltage	V ⁺	40	V
Output current	I _O	100	mA
Reference output current	I _{REF}	50	mA
Power dissipation	P _D	800	mW

Block Diagram



Terminal Connection



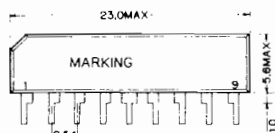
Absolute Maximum Ratings

Supply Voltage	V_{+}/V_{-}	$\pm 18V$
Power Dissipation	P_D	500mW

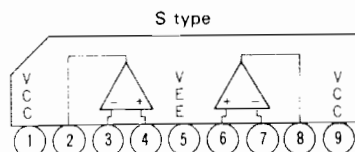
Electrical Characteristics ($T_a = 25^{\circ}C$, $V_{+} = 15V$, $V_{-} = -15V$)

			min	typ	max
Input Offset Voltage	V_{IO}	($R_S \leq 10k\Omega$)		0.5	6mV
Input Offset Current	I_{IO}			5	200nA
Input Bias Voltage	I_{BI}			50	500mA
Voltage Gain	A_V	($R_L \geq 2k\Omega$, $V_O = \pm 10V$)	20	100	($\times 10^3$)
Common Mode Rejection Ratio	CMRR	($R_S \leq 10k\Omega$)	70	90	dB
Slew Rate	SR	($R_L \geq 2k\Omega$)		1	V/ μs

Outward Form

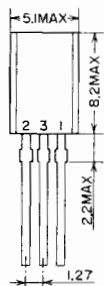


Block Diagram

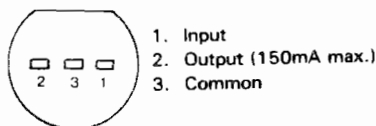


■ TA78L005P	051-0277-00	
005AP	051-0352-00	
006P	051-0296-00	
006AP	051-0296-01	3 terminal regulator
007AP	051-0622-00	
008P	051-0266-00	
008AP	051-0266-01	

Outward Form



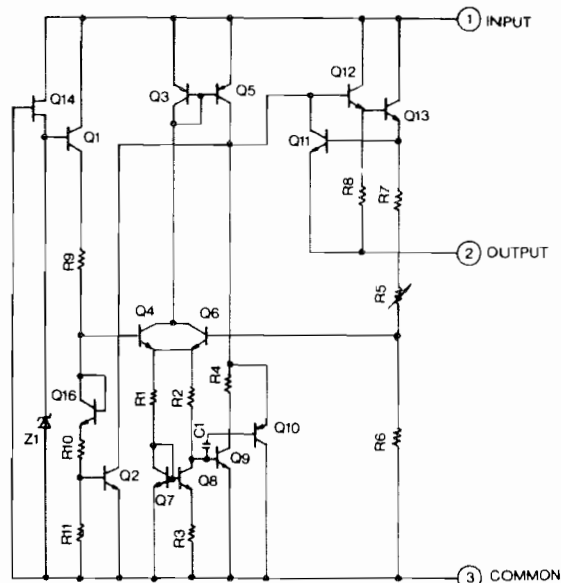
Terminal Structure



Maximum Ratings

Input voltage	V_{IN}	35V
Power dissipation	P_D	800mW

Equivalent Circuit



Electrical Characteristics

	TA78L005P	TA78L005AP
Output voltage	4.6V to 5.4V ($7.0V \leq V_{in} \leq 20V$) ($1.0mA \leq I_{out} \leq 40mA$) 4.6V to 5.4V ($V_{in} = 10V$) ($1.0mA \leq I_{out} \leq 70mA$)	4.75V to 5.25V ($7.0V \leq V_{in} \leq 20V$) ($1.0mA \leq I_{out} \leq 40mA$) 4.75V to 5.25V ($V_{in} = 10V$) ($1.0mA \leq I_{out} \leq 70mA$)
Bias current	6.0mA max. ($T_j = 25^{\circ}C$) 5.5mA max. ($T_j = 125^{\circ}C$)	6.0mA max. ($T_j = 25^{\circ}C$) 5.5mA max. ($T_j = 125^{\circ}C$)
Ripple regulating factor	40dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $8.0V \leq V_{in} \leq 18V$)	41dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $8.0V \leq V_{in} \leq 18V$)
Min I/O voltage difference	1.7V ($T_j = 25^{\circ}C$)	1.7V ($T_j = 25^{\circ}C$)

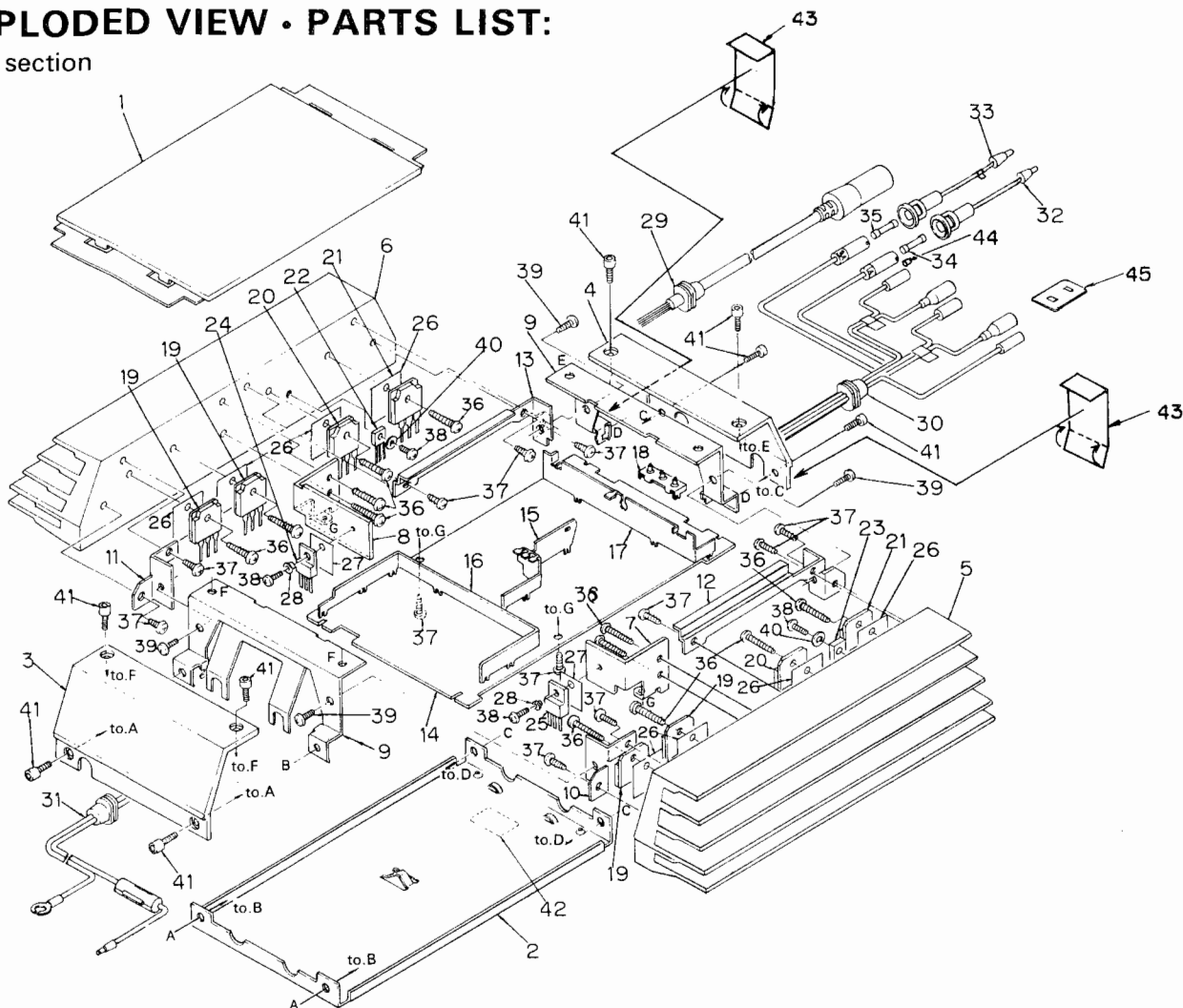
	TA78L006P	TA78L006AP
Output voltage	5.52V to 6.48V ($8.1V \leq V_{in} \leq 21V$) ($1.0mA \leq I_{out} \leq 40mA$) 5.52V to 6.48V ($V_{in} = 11V$) ($1.0mA \leq I_{out} \leq 70mA$)	5.7V to 6.3V ($8.1V \leq V_{in} \leq 21V$) ($1.0mA \leq I_{out} \leq 40mA$) 5.7V to 6.3V ($V_{in} = 11V$) ($1.0mA \leq I_{out} \leq 70mA$)
Bias current	6.0mA max. ($T_j = 25^{\circ}C$) 5.5mA max. ($T_j = 125^{\circ}C$)	6.0mA max. ($T_j = 25^{\circ}C$) 5.5mA max. ($T_j = 125^{\circ}C$)
Ripple regulating factor	38dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $9.0V \leq V_{in} \leq 19V$)	39dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $9.0V \leq V_{in} \leq 19V$)
Min I/O voltage difference	1.7V ($T_j = 25^{\circ}C$)	1.7V ($T_j = 25^{\circ}C$)

	TA78L007AP
Output voltage	6.65V to 7.35V ($9.2V \leq V_{in} \leq 22V$) ($1.0mA \leq I_{out} \leq 40mA$) 6.65V to 7.35V ($V_{in} = 12V$) ($1.0mA \leq I_{out} \leq 70mA$)
Bias current	6.5mA max. ($T_j = 25^{\circ}C$) 6.0mA max. ($T_j = 125^{\circ}C$)
Ripple regulating factor	37dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $10V \leq V_{in} \leq 20V$)
Min I/O voltage difference	1.7V ($T_j = 25^{\circ}C$)

	TA78L008P	TA78L008AP
Output voltage	7.36V to 8.64V ($10.5V \leq V_{in} \leq 23V$) ($1.0mA \leq I_{out} \leq 40mA$) 7.36V to 8.64V ($V_{in} = 14V$) ($1.0mA \leq I_{out} \leq 70mA$)	7.6V to 8.4V ($10.5V \leq V_{in} \leq 23V$) ($1.0mA \leq I_{out} \leq 40mA$) 7.6V to 8.4V ($V_{in} = 14V$) ($1.0mA \leq I_{out} \leq 70mA$)
Bias current	6.5mA max. ($T_j = 25^{\circ}C$) 6.0mA max. ($T_j = 125^{\circ}C$)	6.5mA max. ($T_j = 25^{\circ}C$) 6.0mA max. ($T_j = 125^{\circ}C$)
Ripple regulating factor	36dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $12V \leq V_{in} \leq 23V$)	37dB min. ($T_j = 25^{\circ}C$) ($f = 120Hz$, $12V \leq V_{in} \leq 23V$)
Min I/O voltage difference	1.7V ($T_j = 25^{\circ}C$)	1.7V ($T_j = 25^{\circ}C$)

EXPLODED VIEW • PARTS LIST:

© Main section



REF.NO.	PART NO. (ORDER NO.)	DESCRIPTION	Q'TY
1	310-1241-00	Upper case	1
2	311-1204-00	Lower case	1
3	305-0223-02	Side cover	1
4	305-0223-03	Side cover	1
5	313-1236-00	Heat sink	1
6	313-1236-01	Heat sink	1
7	313-1247-00	Heat sink	1
8	313-1248-00	Heat sink	1
9	309-0547-00	Front plate	2
10	330-8292-00	Plate	1
11	330-8292-01	Plate	1
12	330-8293-00	Plate	1
13	330-8293-01	Plate	1
14	099-7734-00	P.W.B	1
15	330-8294-00	Earth plate	1
16	330-8295-00	Earth plate	1
17	330-8296-00	Shield plate	1
18	944-0712-00	Filter ass'y	1
19	103-0717-00	Transistor	4
20	102-3181-15	Transistor	2
21	100-1264-15	Transistor	2
22	100-0885-00	Transistor	1
23	102-1846-00	Transistor	1

REF.NO.	PART NO. (ORDER NO.)	DESCRIPTION	Q'TY
24	001-0293-50	Diode	1
25	001-0293-51	Diode	1
26	078-0049-00	Insulator sheet	8
27	078-0055-00	Insulator sheet	2
28	078-0055-01	Insulator sheet	2
29	852-8611-00	Extension lead	1
30	852-8739-01	Extension lead	1
31	852-8740-02	Extension lead	1
32	850-2327-01	A-lead	1
33	850-2325-01	A-lead	1
34	120-0010-03	Fuse (1A)	1
35	120-0030-00	Fuse (3A)	1
36	716-0452-01	Screw	12
37	716-0445-02	Screw	12
38	714-3008-89	Machine screw (M3x8)	4
39	731-3006-80	Tap tight (M3x6)	4
40	740-3000-11	Flat washer	2
41	716-0332-02	Screw	8
42	286-5831-00	Set plate	1
43	347-1933-00	Insulator	2
44	010-1610-01	Coil	1
45	285-0838-01	Guide label	1

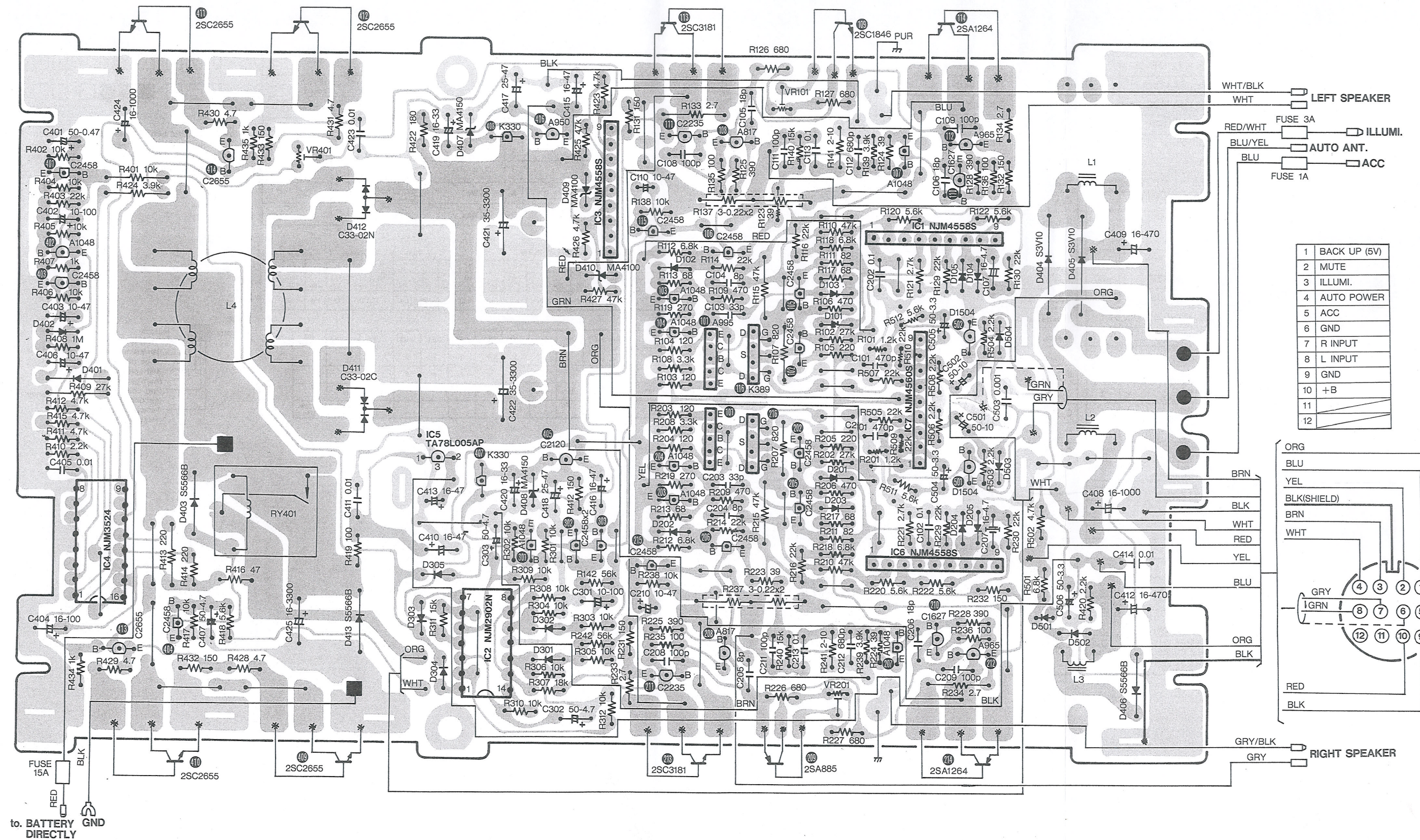
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802HA

PRINTED WIRING BOARD:





■ PARTS LIST:

◎Electrical section

REF.NO.	PART NO. (ORDER NO.)	DESCRIPTION	Q'TY
D ₄₁₁	001-0293-50	Diode (C33-02C)	1
D ₄₁₂	001-0293-51	Diode (C33-02N)	1
D _{101~105 201~205 301,302,303,304 305,401,402,501 502}	001-0330-00	Diode (1SS199)	19
D _{403,406,413}	001-0360-00	Diode (S5566B)	3
D _{503,504}	001-0366-00	Diode (LTZ-MR15)	2
D _{407,408}	001-0377-64	Diode (MA4150)	2
D _{409,410}	001-0423-25	Diode (MA4100)	2
D _{404,405}	001-0429-00	Diode (S3V10)	2
L ₄	007-1098-00	Output trans	1
L ₃	009-0470-02	Choke	1
L _{1,2}	009-0592-01	Choke	2
VR ₄₀₁	012-3808-03	Variable resistor (2.2kΩ B)	1
VR _{101,201}	012-4101-03	Variable resistor (2.2kΩ B)	2
RY ₄₀₁	014-0523-01	Relay	1
IC ₅	051-0277-00	IC (TA78L005P)	1
IC _{1,3,6}	051-0285-51	IC (NJM4558S)	3
IC ₇	051-0285-56	IC (NJM4560S)	1
IC ₂	051-0287-50	IC (NJM2902)	1
IC ₄	051-0749-00	IC (NJM3524)	1
Q _{101,201}	100-0995-06	Transistor (2SA995F)	2
Q _{114,214}	100-1264-15	Transistor (2SA1264-O)	2
Q _{113,213}	102-3181-15	Transistor (2SC3181-O)	2
Q _{409,410,411,412}	103-0717-00	Transistor (2SD717-OY)	4
Q ₂₀₉	100-0885-00	Transistor (2SA885)	1
Q ₁₀₉	102-1846-00	Transistor (2SC1846)	1
Q _{501,502}	103-1504-00	Transistor (2SD1504-D)	2
Q _{108,208}	100-0817-25	Transistor (2SA817-Y)	2
	100-0817-15	Transistor (2SA817-O)	2
Q ₄₀₅	100-0950-00	Transistor (2SA950)	1
Q _{112,212}	100-0965-15	Transistor (2SA965-O)	2
	100-0965-25	Transistor (2SA965-Y)	2
Q _{110,210}	102-1627-25	Transistor (2SC1627-Y)	2
	102-1627-15	Transistor (2SC1627-O)	2
Q ₄₀₅	102-2120-00	Transistor (2SC2120-OY)	1
Q _{111,211}	102-2235-15	Transistor (2SC2235-O)	2
	102-2235-25	Transistor (2SC2235-Y)	2

REF.NO.	PART NO. (ORDER NO.)	DESCRIPTION	Q'TY
Q _{413,414}	102-2655-00	Transistor (2SC2655)	2
Q _{407,408}	108-0330-28	Transistor (2SK330-GR)	2
Q _{116,216}	108-0389-00	Transistor (2SK389-GRBLV)	2
Q _{103,104,107,203 204,207,301,402}	100-1048-25	Transistor (2SA1048-Y)	8
	100-1048-15	Transistor (2SA1048-O)	8
Q _{102,105,106,115 202,205,206,215 302,303,401,403 404}	102-2458-25	Transistor (2SC2458-Y)	13
	102-2458-15	Transistor (2SC2458-O)	13
R _{137,237}	032-0057-03	Cement resistor (0.22Ωx2)	2
R _{107,207}	032-0086-00	Film resistor (820Ω)	2
R _{115,215}	032-0086-01	Film resistor (47kΩ)	2
R _{141,241}	114-1001-21	Film resistor (2W10Ω) OM	2
C _{421,422}	042-0294-01	Tantalum capacitor (35V3300μF)	2
C ₄₂₅	042-0317-00	Tantalum capacitor (16V3300μF)	1
C _{501,502}	042-0349-00	Tantalum capacitor (50V10μF)	2
C _{108,109,111 208,209,211}	160-1012-05	Ceramic capacitor (100pF) HD	6
C _{112,212}	160-6812-05	Ceramic capacitor (680pF) HD	2
C ₅₀₃	173-1022-10	Polyester capacitor (1000pF) S	1
C _{405,411,414,423}	173-1032-10	Polyester capacitor (50V0.01μF) S	4
C _{102,113,202,213}	173-1042-10	Polyester capacitor (50V0.1μF) S	4
C _{101,201}	173-4712-10	Polyester capacitor (50V470μF) S	2
C _{105,106,205,206}	174-1800-13	Ceramic capacitor (18pF) TC	4
C _{103,203}	174-3300-13	Ceramic capacitor (33pF) TC	2
C _{104,204}	174-8090-13	Ceramic capacitor (8pF) TC	2
C _{301,402}	179-1073-22	Electrolytic capacitor (10V100μF) S	2
C ₄₀₄	179-1073-32	Electrolytic capacitor (16V100μF) S	1
C _{408,424}	179-1083-33	Electrolytic capacitor (16V1000μF) S	2
C ₅₀₆	179-3353-62	Electrolytic capacitor (50V3.3μF) S	1
C _{419,420}	179-3363-32	Electrolytic capacitor (16V33μF) S	2
C ₄₀₁	179-4743-62	Electrolytic capacitor (50V0.47μF) S	1
C _{302,303,407}	179-4753-62	Electrolytic capacitor (50V4.7μF) S	3
C _{110,210,403,406 413}	179-4763-22	Electrolytic capacitor (10V47μF) S	5
C _{410,415,416}	179-4763-32	Electrolytic capacitor (16V47μF) S	3
C _{417,418}	179-4763-42	Electrolytic capacitor (25V47μF) S	2
C _{409,412}	179-4773-33	Electrolytic capacitor (16V470μF) S	2
C _{504,505}	182-3353-62	Electrolytic capacitor (50V3.3μF) SS	2
C _{107,207}	182-4756-32	Electrolytic capacitor (16V4.7μF) SS	2

Note : OM (Oxidized Metal)
S (Small)
HD (Higher Dielectric)
SC (Semi-Conductor)
SS (Super Small)
TC (Temperature-Compensating)
LL (Low Leak)
USS (Ultra Super Small)

● How to read resistor

Resistors are deleted from the table of electric components, (except metal film resistors and special resistors). They can be converted to product Nos. as follows.

Film resistor (Carbon film resistor)



Classification	Resistance *	Tolerance of the value of resistance	Rated power	Shape
111		0	0	0
	Example	1 ± 5 %	1 1/8 W	1 Horizontal
	33Ω = 330	2	2 1/8 Ws	2 Vertical
	33kΩ = 333	3	3	3
		4	4 1/2 W	4
			7 1/8 W	7
			8 1/8 Ws	8
			9 1/8 Wss	9

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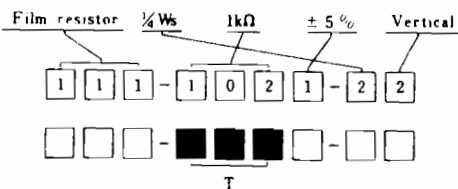
Example of conversion of resistance ■■■■

Note) R : Resistance. T : Converted value

R	T	R	T	R	T	R	T	R	T	R	T	R	T	R	T	R	T	R	T
Ω	108	Ω	109	Ω	100	Ω	101	kΩ	102	kΩ	103	kΩ	104	MΩ	105	MΩ	106	MΩ	107
0 1		1 0		10		100		1 0		10		100		1 0		10		100	
0 15	158	1 5	159	15	150	150	151	1 5	152	15	153	150	154	1 5	155	15	156	150	157

COLOR	BLK	BRN	RED	ORG	YEL	GRN	BLU	PUR	GRY	WHT	GOLD	SILVER	NO COLOR
1st color band	0	1	2	3	4	5	6	7	8	9			
2nd color band	0	1	2	3	4	5	6	7	8	9			
3rd color band	10 ⁰	10 ¹	10 ²	10 ³	10 ⁴	10 ⁵	10 ⁶				10 ⁻¹	10 ⁻²	
4th color band											± 5 % (J)	± 10 % (K)	± 20 % (M)

(Example)



Note 1 The first two of three digits representing resistance are effective digits and the last one represents number of "0" following this
Unit is given in ohm (Ω).

